

Claims

We claim:

1 1. A method for computing an average bits/frame (BA) for frames extracted from a buffer used
2 for video encoding and decoding, each said frame having a same number of fields, said BA equal
3 to $(BR + BR1/J1)/J2$, said BR1, J1, and J2 each a positive integer, said BR a bit rate in bits/sec,
4 said BR1/BR a positive integer, said method comprising:

5 determining BR1, J1, and J2 such that $J2/(1+(BR1/BR)/J1)$ as evaluated in floating point
6 is approximately equal to FR, said FR a frame rate in frames/sec;

7 calculating a quotient Q1 and remainder R1 from integer division of BR1 by J1;

8 calculating a quotient Q2 and remainder R2 from integer division of $(BR+Q1)$ by J2;

9 initializing to zero accumulators A1 and A2; and

10 executing N iterations, wherein $N > 1$, and wherein executing each iteration includes:

11 adding R1 to A1;

12 if $A1 \geq J1$, then adding 1 to A2 and decrementing A1 by J1;

13 setting $BA=Q2$ and adding R2 to A2;

14 if $A2 \geq J2$, then adding 1 to BA and decrementing A2 by J2.

1 2. The method of claim 1, wherein determining BR1, J1, and J2 includes computing BR1, J1, and
2 J2.

1 3. The method of claim 1, wherein determining BR1, J1, and J2 includes receiving as input BR1,
2 J1, and J2.

1 4. The method of claim 1, wherein J1 is a multiple of 10.

1 5. The method of claim 1, wherein $J1 > J2$.

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1 6. A computer code that computes an average bits/frame (BA) for frames extracted from a buffer
2 used for video encoding and decoding, each said frame having a same number of fields, said BA
3 equal to $(BR + BR1/J1)/J2$, said BR1, J1, and J2 each a positive integer, said BR a bit rate in
4 bits/sec, said BR1/BR a positive integer, said computer code including an algorithm programmed
5 to:

6 determine BR1, J1, and J2 such that $J2/(1+(BR1/BR)/J1)$ as evaluated in floating point is
7 approximately equal to FR, said FR a frame rate in frames/sec;

8 calculate a quotient Q1 and remainder R1 from integer division of BR1 by J1;

9 calculate a quotient Q2 and remainder R2 from integer division of $(BR+Q1)$ by J2;

10 initialize to zero accumulators A1 and A2; and

11 execute N iterations, wherein $N > 1$, and wherein to execute each iteration includes:

12 to add R1 to A1;

13 if $A1 \geq J1$, then to add 1 to A2 and to decrement A1 by J1;

14 to set $BA=Q2$ and to add R2 to A2; and

15 if $A2 \geq J2$, then to add 1 to BA and to decrement A2 by J2.

1 7. The computer code of claim 6, wherein to determine BR1, J1, and J2 includes to compute
2 BR1, J1, and J2.

1 8. The computer code of claim 6, wherein to determine BR1, J1, and J2 includes to receive as
2 input BR1, J1, and J2.

1 9. The computer code of claim 6, wherein J1 is a multiple of 10.

1 10. The computer code of claim 6, wherein $J1 > J2$.

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1 11. A method of computing an average bits/frame (BA) for frames extracted from a buffer used
2 for video encoding and decoding, each said frame having a variable number of fields,
3 comprising:

4 defining BA1 as an average bits/frame for a two-field frame, said BA1 equal to $(BR +$
5 $BR1/J1)/J2$, said BR1, J1, and J2 each a positive integer, said BR a bit rate in bits/sec, said
6 $BR1/BR$ a positive integer;

7 defining BA2 as an average bits/frame for a one-field frame, said BA2 equal to $(BR +$
8 $BR1/J1)/(2*J2)$;

9 determining BR1, J1, and J2 such that $J2/(1+(BR1/BR)/J1)$ as evaluated in floating point
10 is approximately equal to FR, said FR a frame rate in frames/sec;

11 calculating a quotient Q1 and remainder R1 from integer division $BR1/J1$;

12 calculating a quotient Q2 and remainder R2 from integer division $(BR+Q1)/J2$;

13 calculating a quotient Q3 and remainder R3 from integer division $(BR+Q1)/(2*J2)$;

14 initializing to zero accumulators A1, A2, B1, and B2;

15 executing N iterations, wherein $N > 1$, said executing iteration n of N relating to
16 extracting a frame n from the buffer, said executing of iteration n including:

17 calculating BA1, including:

18 adding R1 to A1;

19 if $A1 \geq J1$ then adding 1 to A2 and decrementing A1 by J1;

20 setting $BA1=Q2$ and adding R2 to A2;

21 if $A2 \geq J2$, then adding 1 to BA1 and decrementing A2 by J2;

22 determining a number of fields F_n comprised by the frame n ;
 23 if F_n is even then setting $BA2=0$ else calculating $BA2$ including:
 24 adding $R1$ to $B1$;
 25 if $B1 \geq J1$, then adding 1 to $B2$ and decrementing $B1$ by $J1$;
 26 setting $BA2=Q3$ and adding $R3$ to $B2$;
 27 if $B2 \geq (2*J2)$, then adding 1 to $BA2$ and decrementing $B2$ by $(2*J2)$;
 28 computing $BA=(F_n/2)*BA1 + BA2$, said $(F_n/2)$ computed by integer division.

12. The method of claim 11, wherein F_n is 2 or 3.

13. The method of claim 11, wherein determining $BR1$, $J1$, and $J2$ includes computing $BR1$, $J1$, and $J2$.

14. The method of claim 11 wherein determining $BR1$, $J1$, and $J2$ includes receiving as input $BR1$, $J1$, and $J2$.

15. The method of claim 11, wherein $J1$ is a multiple of 10.

16. The method of claim 11 wherein $J1 > J2$.

1 17. A computer code that computes an average bits/frame (BA) for frames extracted from a
2 buffer used for video encoding and decoding, each said frame having a variable number of fields,
3 said BA a function of BA1 and BA2, said BA1 defined as an average bits/frame for a two-field
4 frame, said BA1 equal to $(BR + BR1/J1)/J2$, said BR1, J1, and J2 each a positive integer, said
5 BR a bit rate in bits/sec, said BR1/BR a positive integer, said BA2 defined as an average
6 bits/frame for a one-field frame, said BA2 equal to $(BR + BR1/J1)/(2*J2)$, said computer code
7 including an algorithm, said algorithm programmed to:

8 determine BR1, J1, and J2 such that $J2/(1+(BR1/BR)/J1)$ as evaluated in floating point is
9 approximately equal to FR, said FR a frame rate in frames/sec;

10 calculate a quotient Q1 and remainder R1 from integer division $BR1/J1$;

11 calculate a quotient Q2 and remainder R2 from integer division $(BR+Q1)/J2$;

12 calculate a quotient Q3 and remainder R3 from integer division $(BR+Q1)/(2*J2)$;

13 initialize to zero accumulators A1, A2, B1, and B2;

14 execute N iterations, wherein $N > 1$, said iteration n of N relating to extracting a frame n
15 from the buffer, wherein to execute iteration n includes:

16 to calculate BA1, including:

17 to add R1 to A1;

18 if $A1 \geq J1$ then to add 1 to A2 and to decrement A1 by J1;

19 to set $BA1=Q2$ and to add R2 to A2;

20 if $A2 \geq J2$, then to add 1 to BA1 and to decrement A2 by J2;

21 to determine a number of fields F_n comprised by the frame n;

22 if F_n is even then to set $BA2=0$ else to calculate $BA2$ including:
 23 to add $R1$ to $B1$;
 24 if $B1 \geq J1$, then to add 1 to $B2$ and to decrement $B1$ by $J1$;
 25 to set $BA2=Q3$ and to add $R3$ to $B2$;
 26 to compute $BA=(F_n/2)*BA1 + BA2$, said $(F_n/2)$ computed by integer division.

1 18. The computer code of claim 17, wherein F_n is 2 or 3.

2 19. The computer code of claim 17, wherein to determine $BR1$, $J1$, and $J2$ includes to compute
 3 $BR1$, $J1$, and $J2$.

4 20. The computer code of claim 17 wherein to determine $BR1$, $J1$, and $J2$ includes to receive as
 5 input $BR1$, $J1$, and $J2$.

6 21. The computer code of claim 17, wherein $J1$ is a multiple of 10.

7 22. The computer code of claim 17 wherein $J1 > J2$.

23. A method for computing Z, said $Z = \sum_n Z_n$, said \sum_n denoting a summation over n from 1 to N, said N a positive integer of at least 1, said $Z_n = X_n/Y$, said $X_n = (I_{1n}/J_1)M_{1n} + (I_{2n}/J_2)M_{2n} + \dots + (I_{Kn}/J_K)M_{Kn}$, said Y and said I_{kn}, J_k, M_{kn} ($k=1, 2, \dots, K$) each a positive integer, said K a positive integer of at least 1, said method comprising:

setting $Z=0$, $B=0$, and $A_k=0$ for $k=1, 2, \dots, K$;

executing N iterations, said executing of iteration n of N including:

calculating a quotient Q_{kn} and a remainder R_{kn} from integer division I_{kn}/J_k for $k=1,$

$2, \dots, K$;

calculating $X_n = \sum_k [Q_{kn}M_{kn}]$ as summed over k from 1 to K;

adding $R_{kn}M_{kn}$ to A_k for $k=1, 2, \dots, K$;

for $k = 1, 2, \dots, K$, if $A_k \geq J_k$, then adding 1 to B and decrementing A_k by J_k ;

if $Y \neq 1$ then calculating a quotient Q_n and a remainder R_n from integer division X_n/Y , else setting $Q_n = X_n$ and $R_n = 0$;

setting $Z_n = Q_n$ and adding R_n to B;

if $B \geq Y$, then calculating $Z_n = Z_n + 1$ and decrementing B by Y;

adding Z_n to Z.

24. The method of claim 23, further comprising:

computing $S = B + \sum_k (A_k/J_k)/Y$, said $\sum_k (A_k/J_k)$ denoting a summation over k from 1 to

K, said S computed in floating point; and

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adding S to Z.

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25. The method of claim 23, wherein $Y \neq 1$.

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26. The method of claim 23, wherein $Y=1$.

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1 27. A computer code that computes Z, said $Z = \sum_n Z_n$, said \sum_n denoting a summation over n
2 from 1 to N, said N a positive integer of at least 1, said $Z_n = X_n/Y$, said $X_n = (I_{1n}/J_1)M_{1n} +$
3 $(I_{2n}/J_2)M_{2n} + \dots + (I_{Kn}/J_K)M_{Kn}$, said Y and said I_{kn} , J_k , M_{kn} ($k=1, 2, \dots, K$) each a positive integer,
4 said K a positive integer of at least 1, said computer code including an algorithm, said algorithm
5 programmed to:

6 set $Z=0$, $B=0$, and $A_k=0$ for $k=1, 2, \dots, K$;

7 execute N iterations, wherein to execute iteration n of N includes:

8 to calculate a quotient Q_{kn} and a remainder R_{kn} from integer division I_{kn}/J_k for $k=1,$
9 $2, \dots, K$;

10 to calculate $X_n = \sum_k [Q_{kn}M_{kn}]$ as summed over k from 1 to K;

11 to add $R_{kn}M_{kn}$ to A_k for $k=1, 2, \dots, K$;

12 for $k = 1, 2, \dots, K$, if $A_k \geq J_k$, then to add 1 to B and to decrement A_k by J_k ;

13 if $Y \neq 1$ then to calculate a quotient Q_n and a remainder R_n from integer division
14 X_n/Y , else to set $Q_n = X_n$ and $R_n = 0$;

15 to set $Z_n = Q_n$ and to add R_n to B;

16 if $B \geq Y$, then to calculate $Z_n = Z_n + 1$ and to decrement B by Y;

17 to add Z_n to Z.

1 28. The computer code of claim 27, said algorithm further programmed to:

2 compute $S = [B + \sum_k (A_k/J_k)]/Y$, said $\sum_k (A_k/J_k)$ denoting a summation over k from 1 to

3 K, said S computed in floating point; and

4 add S to Z.

1 29. The computer code of claim 27, wherein $Y \neq 1$.

1 30. The computer code of claim 27, wherein $Y=1$.

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1 31. A computer program product, comprising a computer usable medium having a computer
2 readable program code embodied therein, wherein the computer code computes an average
3 bits/frame (BA) for frames extracted from a buffer used for video encoding and decoding, each
4 said frame having a same number of fields, said BA equal to $(BR + BR1/J1)/J2$, said BR1, J1,
5 and J2 each a positive integer, said BR a bit rate in bits/sec, said BR1/BR a positive integer, said
6 computer code including an algorithm programmed to:

7 determine BR1, J1, and J2 such that $J2/(1+(BR1/BR)/J1)$ as evaluated in floating point is
8 approximately equal to FR, said FR a frame rate in frames/sec;

9 calculate a quotient Q1 and remainder R1 from integer division of BR1 by J1;

10 calculate a quotient Q2 and remainder R2 from integer division of $(BR+Q1)$ by J2;

11 initialize to zero accumulators A1 and A2; and

12 execute N iterations, wherein $N > 1$, and wherein to execute each iteration includes:

13 to add R1 to A1;

14 if $A1 \geq J1$, then to add 1 to A2 and to decrement A1 by J1;

15 to set $BA=Q2$ and to add R2 to A2; and

16 if $A2 \geq J2$, then to add 1 to BA and to decrement A2 by J2.

32. A computer program product, comprising a computer usable medium having a computer readable program code embodied therein, wherein the computer code computes an average bits/frame (BA) for frames extracted from a buffer used for video encoding and decoding, each said frame having a variable number of fields, said BA a function of BA1 and BA2, said BA1 defined as an average bits/frame for a two-field frame, said BA1 equal to $(BR + BR1/J1)/J2$, said BR1, J1, and J2 each a positive integer, said BR a bit rate in bits/sec, said BR1/BR a positive integer, said BA2 defined as an average bits/frame for a one-field frame, said BA2 equal to $(BR + BR1/J1)/(2*J2)$, said computer code including an algorithm, said algorithm programmed to:

determine BR1, J1, and J2 such that $J2/(1+(BR1/BR)/J1)$ as evaluated in floating point is approximately equal to FR, said FR a frame rate in frames/sec;

calculate a quotient Q1 and remainder R1 from integer division $BR1/J1$;

calculate a quotient Q2 and remainder R2 from integer division $(BR+Q1)/J2$;

calculate a quotient Q3 and remainder R3 from integer division $(BR+Q1)/(2*J2)$;

initialize to zero accumulators A1, A2, B1, and B2;

execute N iterations, said N at least 1, said iteration n of N relating to extracting a frame n from the buffer, wherein to execute iteration n includes:

to calculate BA1, including:

to add R1 to A1;

if $A1 \geq J1$ then to add 1 to A2 and to decrement A1 by J1;

to set $BA1=Q2$ and to add R2 to A2;

if $A2 \geq J2$, then to add 1 to BA1 and to decrement A2 by J2;

22 to determine a number of fields F_n comprised by the frame n;
23 if F_n is even then to set $BA2=0$ else to calculate $BA2$ including:
24 to add $R1$ to $B1$;
25 if $B1 \geq J1$, then to add 1 to $B2$ and to decrement $B1$ by $J1$;
26 to set $BA2=Q3$ and to add $R3$ to $B2$;
27 to compute $BA=(F_n/2)*BA1 + BA2$, said $(F_n/2)$ computed by integer division.

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33. A computer program product, comprising a computer usable medium having a computer readable program code embodied therein, wherein the computer code computes Z , said $Z = \sum_n Z_n$, said \sum_n denoting a summation over n from 1 to N , said N a positive integer of at least 1, said $Z_n = X_n/Y$, said $X_n = (I_{1n}/J_1)M_{1n} + (I_{2n}/J_2)M_{2n} + \dots + (I_{Kn}/J_K)M_{Kn}$, said Y and said I_{kn} , J_k , M_{kn} ($k=1, 2, \dots, K$) each a positive integer, said K a positive integer of at least 1, said computer code including an algorithm, said algorithm programmed to:

set $Z=0$, $B=0$, and $A_k=0$ for $k=1, 2, \dots, K$;

execute N iterations, wherein to execute iteration n of N includes:

to calculate a quotient Q_{kn} and a remainder R_{kn} from integer division I_{kn}/J_k for $k=1, 2, \dots, K$;

to calculate $X_n = \sum_k [Q_{kn}M_{kn}]$ as summed over k from 1 to K ;

to add $R_{kn}M_{kn}$ to A_k for $k=1, 2, \dots, K$;

for $k = 1, 2, \dots, K$, if $A_k \geq J_k$, then to add 1 to B and to decrement A_k by J_k ;

if $Y \neq 1$ then to calculate a quotient Q_n and a remainder R_n from integer division X_n/Y , else to set $Q_n = X_n$ and $R_n = 0$;

to set $Z_n = Q_n$ and to add R_n to B ;

if $B \geq Y$, then to calculate $Z_n = Z_n + 1$ and to decrement B by Y ;

to add Z_n to Z .